

UC 12307 135

CBM003 ADD/CHANGE FORM

APPROVED APR 24 2013

<input checked="" type="checkbox"/> Undergraduate Council <input type="checkbox"/> New Course <input checked="" type="checkbox"/> Course Change Core Category: <u>Math</u> Effective Fall <del>2013</del> <u>2014</u>	or	<input type="checkbox"/> Graduate/Professional Studies Council <input type="checkbox"/> New Course <input type="checkbox"/> Course Change Effective Fall <u>2013</u>
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1. Department: Mathematics College: NSM
2. Faculty Contact Person: Charles Peters Telephone: 743-3516 Email: charles@math.uh.edu

3. Course Information on New/Revised course:

- Instructional Area / Course Number / Long Course Title:  
MATH / 1311 / Elementary Mathematical Modeling
- Instructional Area / Course Number / Short Course Title (30 characters max.)  
MATH / 1311 / ELEMENTARY MATH MODELING
- SCH: 3.00 Level: FR CIP Code: 27.0101.00.01 Lect Hrs: 3 Lab Hrs: 0

RECEIVED APR - 4 2013

4. Justification for adding/changing course: To meet core curriculum requirements

5. Was the proposed/revised course previously offered as a special topics course?  Yes  No

If Yes, please complete:

- Instructional Area / Course Number / Long Course Title:  
    /    /
- Course ID:      Effective Date (currently active row):

6. Authorized Degree Program(s):     

- Does this course affect major/minor requirements in the College/Department?  Yes  No
- Does this course affect major/minor requirements in other Colleges/Departments?  Yes  No
- Can the course be repeated for credit?  Yes  No (if yes, include in course description)

7. Grade Option: Letter (A, B, C ...) Instruction Type: lecture ONLY (Note: Lect/Lab info. must match item 3, above.)

8. If this form involves a change to an existing course, please obtain the following information from the course inventory: Instructional Area / Course Number / Long Course Title

- MATH / 1311 / Elementary Mathematical Modeling
- Course ID: 31085 Effective Date (currently active row): 6042012

9. Proposed Catalog Description: (If there are no prerequisites, type in "none".)

Cr: 3. (3-0). Prerequisites: A satisfactory score on a placement exam or MATH 1300 Description (30 words max.): May not apply to course or GPA requirements for a major or minor in the College of Natural Sciences and Mathematics. Students may not receive credit for both MATH 1310 and MATH 1311. Functions, graphs, rates of change, mathematics of finance, optimization, and mathematics of decision making.

10. Dean's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print/Type Name: \_\_\_\_\_

## REQUEST FOR COURSES IN THE CORE CURRICULUM

Originating Department or College: Department of Mathematics

Person Making Request: Charles Peters

Telephone: 713-743-3516

Email: charles@math.uh.edu

Dean's Signature: \_\_\_\_\_

Date: 2/13/2013

Course Number and Title: MATH 1311: Elementary Mathematical Modeling

Please attach in separate documents:

Completed CBM003 Add/Change Form with Catalog Description

Syllabus

List the student learning outcomes for the course (Statements of what students will know and be able to do as a result of taking this course. See appended hints for constructing these statements):

Students will understand and be able to apply properties of polynomial, rational, exponential, logarithmic, and power functions in modeling simple real-life scenarios from business, social sciences, the natural sciences, and personal finance. Appropriate choices for modeling come primarily from consideration of rates of growth or decay over discrete increments or from graphical representations of data, possibly data with noise. Students will utilize graphing calculators or spreadsheet programs in simulating and analyzing models. They will translate ordinary language descriptions of a problem into mathematical expression, employ valid, logical approaches to solving the problem, and be able to communicate the results again in ordinary language.

Component Area for which the course is being proposed (check one):

**\*Note:** If you check the Component Area Option, you would need to also check a Foundational Component Area.

Communication

American History

Mathematics

Government/Political Science

Language, Philosophy, & Culture

Social & Behavioral Science

Creative Arts

Component Area Option

Life & Physical Sciences

Competency areas addressed by the course (refer to appended chart for competencies that are required and optional in each component area):

Critical Thinking

Teamwork

Communication Skills

Social Responsibility

Empirical & Quantitative Skills

Personal Responsibility

Because we will be assessing student learning outcomes across multiple core courses, assessments assigned in your course must include assessments of the core competencies. For each competency checked above, indicated the specific course assignment(s) which, when completed by students, will provide evidence of the competency. Provide detailed information, such as copies of the paper or project assignment, copies of individual test items, etc. A single assignment may be used to provide data for multiple competencies.

Critical Thinking:

Several examples of exercises and assignments addressing critical thinking competencies are attached.

Communication Skills:

See attached.

Empirical & Quantitative Skills:

See attached.

Teamwork:

Click here to enter text.

Social Responsibility:

Click here to enter text.

Personal Responsibility:

Click here to enter text.

Will the syllabus vary across multiple section of the course?  Yes  No

If yes, list the assignments that will be constant across sections:

Click here to enter text.

Inclusion in the core is contingent upon the course being offered and taught at least once every other academic year. Courses will be reviewed for renewal every 5 years.

The department understands that instructors will be expected to provide student work and to participate in university-wide assessments of student work. This could include, but may not be limited to, designing instruments such as rubrics, and scoring work by students in this or other courses. In addition, instructors of core courses may be asked to include brief assessment activities in their course.

Dept. Signature: Charles Pitt

The following courses have been reviewed and approved by the NSM Curriculum Committee to meet the new core requirements. Given the length of the individual submissions I have elected to submit these requests by electronic means only.

**Natural Sciences: Core Courses**

BIOL 1309 - Human Genetics and Society  
BIOL 1310 - General Biology  
BIOL 1320 - General Biology  
BIOL 1361 - Introduction to Biological Science I  
BIOL 1362 - Introduction to Biological Science II  
CHEM 1301 - Foundations of Chemistry  
CHEM 1331 - Fundamentals of Chemistry I  
CHEM 1332 - Fundamentals of Chemistry II  
GEOL 1302 - Introduction to Global Climate Change  
GEOL 1330 - Physical Geology  
GEOL 1340 - Introduction to Earth Systems  
GEOL 1350 - Introduction to Meteorology  
GEOL 1360 - Introduction to Oceanography  
GEOL 1376 - Historical Geology  
PHYS 1301 - Introductory General Physics I  
PHYS 1302 - Introductory General Physics II  
PHYS 1321 - University Physics I  
PHYS 1322 - University Physics II

**Mathematics: Core Courses**

MATH 1310 - College Algebra  
~~MATH 1311 - Elementary Mathematical Modeling~~

**Math/Reasoning: Core Courses**

COSC 1306 - Computer Science and Programming  
MATH 1330 - Precalculus

MATH 1431 - Calculus I

MATH 1432 - Calculus II

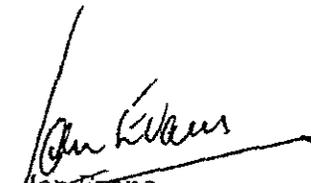
MATH 2311 - Introduction to Probability and Statistics

**Writing in the Disciplines: Core Courses**

BCHS Biochemistry Lab II

BIOL 3311 - Genetics Lab

PHYS 3313 - Advanced Lab I

  
~~Ian Evans~~  
Associate Dean

4/4/13

University of Houston  
 Mathematics Department  
 Math 1311 Elementary Mathematical Modeling

**Course:** MATH 1311 — Elementary Mathematical Modeling

**Prerequisite:** Two credits of high school algebra, one credit of geometry and satisfactory scores on the placement examination.

**Course Description:** Credit 3 hours (3-0). Functions, graphs, differences, and rates of change, mathematical models, mathematics of finance, optimization, and mathematics of decision making. May not be applied to a major or minor in mathematics. Students may not receive credit for both MATH 1310 and MATH 1311.

**Course Requirements**

**Textbook:** *Functions and Change: A Modeling Approach to College Algebra*, Bruce Crauder, Benny Evans and Alan Noell, 3<sup>rd</sup> edition, Houghton Mifflin Company, 2007, ISBN-10: 0-618-64301X.

**Calculator:** A graphing calculator will be required. The text is designed to be used with a TI83 graphing calculator, and the calculator is an essential part of the presentation as well as the exercises. An accompanying *Student Study and Technology Guide*, ISBN-10: 0-618-64303-6, for the textbook provides TI83, TI83+, and TI84 keystrokes for creating tables, graphs, entering expressions, solving equations, and performing various types of regressions.

**Course Objectives**

Upon completion of this course, students will understand and appreciate some of the applications of mathematics to real-world concerns as well as become proficient with basic calculator and computer-generated spreadsheet operations. The student will meet the mandated goals and objectives of the core curriculum requirements in mathematics.

CH. SECTION	OBJECTIVE AND EXAMPLE	SESSION												
<b>CHAPTER 1 — FUNCTIONS</b>														
1.1	<b>Define, evaluate, and use functions given by formulas.</b>	Week 1												
Functions Given by Formulas	Example: Evaluate $M = P(e^r - 1)/(1 - e^{-rt})$ , where $r = 0.1$ , $P = 8300$ , and $t = 24$ .													
1.2	<b>Define, evaluate and use functions given by tables</b>	Week 2												
Functions Given by Tables	Example: Gross domestic product: The following table from the <i>2003 Statistical Abstract of the United States</i> shows the U.S. gross domestic product (GDP) $G$ , in trillion of dollars, as a function of the year $t$ .													
	<table border="1" style="margin-left: 20px;"> <tr> <td>t = Year</td> <td>1996</td> <td>2000</td> <td>2002</td> </tr> <tr> <td>G = GDP</td> <td>7.81</td> <td>9.82</td> <td>10.45</td> </tr> <tr> <td>(trillions of dollars)</td> <td></td> <td></td> <td></td> </tr> </table>	t = Year	1996	2000	2002	G = GDP	7.81	9.82	10.45	(trillions of dollars)				
t = Year	1996	2000	2002											
G = GDP	7.81	9.82	10.45											
(trillions of dollars)														
	a. Explain in practical terms what $G(1996)$ means, and find its value.													
	b. Use functional notation to express the gross domestic product in 1998, and estimate that value.													

c. What is the average yearly rate of change in  $G$  from 2000 to 2002?

d. Use your answer to part c to predict the gross domestic product in the year 2010.

Ch. Section	Objective and Example	Session
1.3 Functions Given by Graphs	<p><b>Define, evaluate and use functions given by graphs.</b></p> <p>Example: A stock market investment: A stock market investment of \$10,000 was made in 197-. During the decade of the 1970s, the stock lost half its value. Beginning in 1980, the value increased until it reached \$35,000 in 1990. After that its value has remained stable. Let <math>v = v(d)</math> denote the value of the stock, in dollars, as a function of the date <math>d</math>.</p> <p>a. What are the values of <math>v(1970)</math>, <math>v(1980)</math>, <math>v(1990)</math>, and <math>v(2000)</math>?</p> <p>b. Make a graph of <math>v</math> against <math>d</math>. Label the axes appropriately.</p> <p>c. Estimate the time when your graph indicates that the value of the stock was most rapidly increasing.</p>	Week 2
1.4 Functions Given by Words	<p><b>Define, evaluate, and use functions given by words.</b></p> <p>Example: United States population growth: In 1960 the population of the United States was about 180 million. Since that time the population has increased by approximately 1.2% each year. This is a verbal description of the function <math>N = N(t)</math>, where <math>N</math> is the population, in millions, and <math>t</math> is the number of years since 1960.</p> <p>a. Express in functional notation the population of the United States in 1963. Calculate its value.</p> <p>b. Use the verbal description of <math>N</math> to make a table of values that shows U.S. population in millions from 1960 through 1965.</p> <p>c. Make a graph of U.S. population versus time. Be sure to label your graph appropriately.</p> <p>d. Verify that the formula <math>180 \times 1.1012^t</math> million people, where <math>t</math> is the number of years since 1960, gives the same values as those you found in the table in part b.</p> <p>e. Assuming that the population has been growing at the same percentage rate since 1960, what value does the formula above give for the population in 2000? (Note: The actual population in 2000 was about 281 million.)</p>	Week 3

CH. SECTION	OBJECTIVE AND EXAMPLE	SESSION												
<b>CHAPTER 2 — GRAPHICAL AND TABULAR ANALYSIS</b>														
2.1 Tables and Trends	<p><b>Define, construct, and analyze tables of values from given formulas.</b></p> <p>Example: The Harvard Step Test was developed in 1943 as a physical fitness test, and modifications of it remain in use today. The candidate steps up and down on a bench 20 inches high 30 times per minute for 5 minutes. The pulse is counted three times for 30 seconds: at 1 minute, 2 minutes, and 3 minutes after the exercise is completed. If <math>P</math> is the sum of the three pulse counts, then the <i>physical efficiency index</i> <math>E</math> is calculated using <math>E = 15,000/P</math>. The following table shows how to interpret the results of the test.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Efficiency Index</th> <th>Interpretation</th> </tr> </thead> <tbody> <tr> <td>Below 55</td> <td>Poor condition</td> </tr> <tr> <td>55 to 64</td> <td>Low average</td> </tr> <tr> <td>65 to 79</td> <td>High average</td> </tr> <tr> <td>80 to 89</td> <td>Good</td> </tr> <tr> <td>90 &amp; above</td> <td>Excellent</td> </tr> </tbody> </table> <p>a. Does the physical efficiency index increase or decrease with increasing values of <math>P</math>? Explain in practical terms what this means.</p> <p>b. Express using functional notation the physical efficiency index of someone whose total pulse count is 200, and then calculate that value.</p> <p>c. What is the physical condition of someone whose total pulse count is 2000?</p> <p>d. What pulse counts will result in an excellent rating?</p>	Efficiency Index	Interpretation	Below 55	Poor condition	55 to 64	Low average	65 to 79	High average	80 to 89	Good	90 & above	Excellent	Week 4
Efficiency Index	Interpretation													
Below 55	Poor condition													
55 to 64	Low average													
65 to 79	High average													
80 to 89	Good													
90 & above	Excellent													
2.2 Graphs	<p><b>Define, construct, and analyze graphs for given functions.</b></p> <p>Example: The resale value <math>V</math>, in dollars, of a certain car is a function of the number of years <math>t</math> since the year 2000. In the year 2000 the resale value is \$18,000, and each year thereafter the resale value decreases by \$1700.</p> <p>a) What is the resale value in the year 20001?</p> <p>b) Find a formula for <math>V</math> as a function of <math>t</math>.</p> <p>c) Make a graph of <math>V</math> versus <math>t</math> covering the first 4 years since the year 2000.</p> <p>d) Use functional notation to express the resale value in the year 2003, and then calculate that value.</p>	Week 4												

CH . SECTION	OBJECTIVE AND EXAMPLE	SESSION
2.3 Solving Linear Equations	<b>Solve linear and non-linear equations.</b> Example 1: Solve for $k$ : $2k + m = 5k + n$ . Example 2: Solve the following equation by a) the single-graph method and b) the crossing-graphs method.	Week 5
2.4 Solving Non-linear Equations	$-x^4/(x^2 + 1) = -1$ (Note: There are two solutions. Find them both.)	
2.5 Optimization	<b>Determine optimum values of functions from their graphs.</b> Example: The weekly profit $P$ for a widget producer is a function of the number $n$ of widgets sold. The formula is $P = -2 + 2.9n - 0.3n^2$ . Here $P$ is measured in thousands of dollars, $n$ is measured in thousands of widgets, and the formula is valid up to a level of 7 thousand widgets sold.  a. Make a graph of $P$ versus $n$ .  b. Calculate $P(0)$ and explain in practical terms what your answer means.  c. At what sales level I the profit as large as possible (maximized)?	Week 5
<b>CHAPTER 3 - STRAIGHT LINES AND LINEAR FUNCTIONS</b>		
3.1 The Geometry of Lines	<b>Determine, analyze, and use the slope of a line.</b> Example: If a building is 100 feet tall and is viewed from a spot on the ground 70 feet away from the base of the building, what is the slope of a line from the spot on the ground to the top of the building?	Week 6
3.2 Linear Functions	<b>Define and use functions of lines with a constant slope.</b> Example: An elementary school is taking a busload of children to a science fair. It costs \$130.00 to drive the bus to the fair and back, and the school pays each student's \$2.00 admission fee.  a) Use a formula to express the total cost $C$ , in dollars, of the science fair trip as a linear function of the number $n$ of children who make the trip.  b) Identify the slope and the initial value of $C$ , and explain in practical terms what they mean.  c) Explain in practical terms what $C(5)$ means, and then calculate that value.  d) Solve the equation $C(n) = 146$ for $n$ . Explain what the answer you get represents.	Week 6

CH. SECTION	OBJECTIVE AND EXAMPLE	SESSION												
3.3 Modeling Data with Linear Functions	<p><b>Determine linear data, define models and evaluate resulting functions.</b></p> <p>Example: Determine if the following data given in the table below is linear. Plot the data from the table and determine the linear function, if applicable, that the data models.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>x</td> <td>2</td> <td>4</td> <td>6</td> <td>8</td> </tr> <tr> <td>y</td> <td>12</td> <td>17</td> <td>22</td> <td>27</td> </tr> </table>	x	2	4	6	8	y	12	17	22	27	Week 7		
x	2	4	6	8										
y	12	17	22	27										
3.4 Linear Regression	<p><b>Use linear regression to approximate linear functions.</b></p> <p>Example: For the following data set: (a) Plot the data. (b) Find the equation of the regression line. (c) Add the graph of the regression line to the plot of the data points.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>x</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>y</td> <td>2.3</td> <td>2</td> <td>1.8</td> <td>1.4</td> <td>1.3</td> </tr> </table>	x	1	2	3	4	5	y	2.3	2	1.8	1.4	1.3	Week 7
x	1	2	3	4	5									
y	2.3	2	1.8	1.4	1.3									
3.5 Systems of Equations	<p><b>Solve systems of two equations in two unknowns.</b></p> <p>Example: Solve the following system of equations by a) the hand calculation method and b) the crossing-graphs method.</p> $-6.6x - 26.5y = 17.1$ $6.9x + 5.5y = 8.4$	Week 8												
<b>CHAPTER 4 — EXPONENTIAL FUNCTIONS</b>														
4.1 Exponential Growth and Decay	<p><b>Define, evaluate and interpret exponential functions.</b></p> <p>Example: Suppose that <math>f</math> is an exponential function with growth factor 2.4 and that <math>f(0) = 3</math>. Find <math>f(2)</math>. Find a formula for <math>f(x)</math>.</p>	Week 9												
4.2 Modeling Exponential Data	<p><b>Determine exponential and nearly exponential data, define models, apply exponential regression and evaluate resulting functions.</b></p> <p>Example 1: Determine whether the following table shows exponential data. If the data is exponential, make an exponential model for the data.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>x</td> <td>0</td> <td>2</td> <td>4</td> <td>6</td> </tr> <tr> <td>y</td> <td>5</td> <td>10</td> <td>20</td> <td>40</td> </tr> </table>	x	0	2	4	6	y	5	10	20	40	Week 9		
x	0	2	4	6										
y	5	10	20	40										
4.3 Modeling Nearly Exponential Data	<p>Example 2: Use exponential regression to fit the following data set. Give the exponential model, and plot the data along with the model.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>x</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>y</td> <td>3.7</td> <td>4.3</td> <td>6.1</td> <td>9.1</td> <td>13.6</td> </tr> </table>	x	1	2	3	4	5	y	3.7	4.3	6.1	9.1	13.6	
x	1	2	3	4	5									
y	3.7	4.3	6.1	9.1	13.6									
CH. SECTION	OBJECTIVE AND EXAMPLE	SESSION												
4.4 Logarithmic Functions	<p><b>Understand and apply common logarithmic functions.</b></p> <p>Example: The largest recorded earthquake centered in Idaho measured 7.2 on the Richter scale.</p> <p>a) The largest recorded earthquake centered in Montana was 3.16 times as powerful as the Idaho earthquake. What was the Richter scale reading for the Montana earthquake?</p> <p>b) The largest recorded earthquake centered in Arizona measured 5.6 on the Richter scale. How did the power of the Idaho quake compare with that of</p>	Week 10												

	the Arizona quake?																					
4.5	<b>Establish and understand the connection between linear and exponential data.</b>	Week 10																				
Connecting Exponential and Linear Functions	Example: The following table, taken from the <i>U.S. Industrial Outlook</i> , shows the average hourly wages for American auto parts production workers from 1987 through 1994.																					
	<table border="1"> <thead> <tr> <th>Date</th> <th>Hourly Wage</th> <th>Date</th> <th>Hourly Wage</th> </tr> </thead> <tbody> <tr> <td>1987</td> <td>\$13.79</td> <td>1991</td> <td>\$15.70</td> </tr> <tr> <td>1988</td> <td>\$14.72</td> <td>1992</td> <td>\$16.15</td> </tr> <tr> <td>1989</td> <td>\$14.99</td> <td>1993</td> <td>\$16.50</td> </tr> <tr> <td>1990</td> <td>\$15.35</td> <td>1994</td> <td>\$16.85</td> </tr> </tbody> </table>	Date	Hourly Wage	Date	Hourly Wage	1987	\$13.79	1991	\$15.70	1988	\$14.72	1992	\$16.15	1989	\$14.99	1993	\$16.50	1990	\$15.35	1994	\$16.85	
Date	Hourly Wage	Date	Hourly Wage																			
1987	\$13.79	1991	\$15.70																			
1988	\$14.72	1992	\$16.15																			
1989	\$14.99	1993	\$16.50																			
1990	\$15.35	1994	\$16.85																			
	<p>a) Plot the natural logarithm of the data. Does it appear that it is reasonable to model auto parts worker wages using an exponential model?</p> <p>b) Find the equation of the regression line for the natural logarithm of the data.</p> <p>c) Make an exponential model for auto parts worker wages using the logarithm as a link.</p>																					
<b>CHAPTER 5 — A SURVEY OF OTHER COMMON FUNCTIONS</b>																						
5.1	<b>Define, evaluate and interpret power functions.</b>	Week 11																				
Power Functions	Example: The speed at which certain animals run is a power function of their stride length, and the power is $k = 1.7$ . If one animal has a stride length three times as long as another, how much faster does it run?																					

CH . SECTION	OBJECTIVE AND EXAMPLE	SESSION										
5.2 Modeling Data with Power Functions	<b>Define and construct power function models from given data.</b>	Week 11										
	<table border="1"> <thead> <tr> <th><math>x</math></th> <th><math>f</math></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3.6</td> </tr> <tr> <td>2</td> <td>8.86</td> </tr> <tr> <td>3</td> <td>15.02</td> </tr> <tr> <td>4</td> <td>21.83</td> </tr> <tr> <td>5</td> <td>29.17</td> </tr> </tbody> </table> <p>Example: The following data table was generated by a power function <math>f</math>. Find a formula for <math>f</math> and plot the data points along with the graph of the function.</p>		$x$	$f$	1	3.6	2	8.86	3	15.02	4	21.83
$x$	$f$											
1	3.6											
2	8.86											
3	15.02											
4	21.83											
5	29.17											
5.3 Combining and Decomposing Functions	<b>Combine and decompose functions.</b>	Week 12										
	<p>Example 1: The radius <math>r</math> of a circle is given as a function of time <math>t</math> by the formula <math>r = 1 + 2t</math>. The area <math>A</math> of the circle is given as a function of the radius <math>r</math> by the formula <math>A = \pi r^2</math>. Find a formula giving the area <math>A</math> as a function of the time <math>t</math>.</p>											
5.4 Quadratic Functions and Parabolas	<b>Define, analyze, and evaluate quadratic functions and their graphs.</b>	Week 13										
	<p>Example: Test the following data to see whether the data are quadratic. If the data is quadratic, use quadratic regression to find a model for the following data set. Plot the data and the model on the same graph.</p> <table border="1"> <thead> <tr> <th><math>x</math></th> <th><math>f</math></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-4</td> </tr> <tr> <td>2</td> <td>-5</td> </tr> <tr> <td>3</td> <td>-8</td> </tr> <tr> <td>4</td> <td>-13</td> </tr> <tr> <td>5</td> <td>-20</td> </tr> </tbody> </table>		$x$	$f$	1	-4	2	-5	3	-8	4	-13
$x$	$f$											
1	-4											
2	-5											
3	-8											
4	-13											
5	-20											
5.5 Higher-degree Polynomials and Rational Functions	<b>Define, analyze, and evaluate quadratic functions and their graphs.</b>	Week 13										
	<p>Example: Use cubic regression to find a model for the following data set. Plot the data and the model on the same graph.</p> <table border="1"> <thead> <tr> <th><math>x</math></th> <th><math>f</math></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> </tr> <tr> <td>3</td> <td>3</td> </tr> <tr> <td>4</td> <td>5</td> </tr> <tr> <td>6</td> <td>2</td> </tr> <tr> <td>7</td> <td>1</td> </tr> </tbody> </table>		$x$	$f$	1	1	3	3	4	5	6	2
$x$	$f$											
1	1											
3	3											
4	5											
6	2											
7	1											
<b>CHAPTER 6 — RATES OF CHANGE</b>												
6.1 Velocity	<b>Describe and analyze velocity and directed distance.</b>	Week 14										
	<p>Example: A rock is tossed upward and reaches its peak 2 seconds after the toss. Its location is determined by its distance up from the ground. What is the sign of velocity at 1 second after the toss, 2 seconds after the toss, and 3 seconds after the toss?</p>											

6.2 Rates of Change for Other Functions	<b>Utilize the fundamental properties of rates of change.</b> Example: Estimating rates of change-Use your calculator to make a graph of $f(x) = x^3 - 5x$ . Is $df/dx$ positive or negative at $x = 2$ ? Identify a point on the graph of $f$ where $df/dx$ is negative.	Week 14
6.3 Estimating Rates of Change	<b>Estimate rates of change.</b> Example: Make a graph of $x^3 - x^2$ and use the calculator to estimate its rate of change at $x = 3$ .	Week 15
6.4 Equations of Change: Linear and Exponential Functions	<b>Analyze equations of change: Linear and Exponential Functions</b> Example: You open an account by investing \$250 with a financial institution that advertises an APR of 5.25%, with continuous compounding. What account balance would you expect 1 year after making your initial investment?	Week 15

**Where to find help:** There are several different ways to find help in the course.

(1) **Instructor:** During his/her office hours or CASA Tutoring hours.

(2) **CASA Tutoring:** 222 GARRISON GYM (2<sup>nd</sup> Floor) for homework exercises.

(3) **LEARNING SUPPORT SERVICES:** 321 SOCIAL WORK BUILDING (3<sup>rd</sup> Floor) for one-on-one free tutoring over concepts, examples, and homework. See link through your instructor's website for more information.

(4) **Online Study Center:** Provided by Houghton Mifflin publishing that provides extra proofs, quizzes, and discovery exercises. See textbook's website at <http://college.hmco.com/PIC/crauder3e>.

**Courseware:** Each student MUST establish a Courseware student account via the internet by the END OF THE SECOND WEEK. Your instructor has a link to Courseware from his/her website. For more information visit <http://CASA.uh.edu>. Students failing to establish a Courseware account will NOT have access to grades or instructor emails.

**Grading System:** The University standard grade system will be used. If  $x$  is your semester numerical score:

<b>A</b>	$x > 93$	<b>B-</b>	$80 \leq x < 83$	<b>D+</b>	$67 \leq x < 70$
<b>A-</b>	$90 \leq x < 93$	<b>C+</b>	$77 \leq x < 80$	<b>D</b>	$63 \leq x < 67$
<b>B+</b>	$87 \leq x < 90$	<b>C</b>	$73 \leq x < 77$	<b>D-</b>	$50 \leq x < 63$
<b>B</b>	$83 \leq x < 87$	<b>C-</b>	$70 \leq x < 73$	<b>F</b>	<i>Below 50</i>

The course grade will be computed as follows:

<b>Homework</b>	10%
<b>Quizzes</b>	10%
<b>Chapter Projects</b>	10%
<b>Tests (3-20% each)</b>	60%
<b>Final Exam</b>	10%

**Homework:** Each section covered will have two types of homework assigned. The first type is the “Skill Building Exercises” which is NOT to be turned in—each section’s assignment will be the all the odd-numbered exercises from this type. The second type comes from the “Exercises”. The “Exercises” homework consists of approximately 10 exercises from each section covered in the textbook. There are approximately 4-5 sections per chapter in the textbook. Homework will be turned in by “chapter”, meaning all the chapter’s “section exercises” will be turned in together upon completion of that chapter. Thus the homework will be due the first day of class of the week following the completion of that chapter (i.e. if a chapter is completed on Wednesday, then all of the homework assigned in each section of that chapter will be due the following Monday). Selected exercise(s) from each section will be graded based on completeness and correctness. We will have SIX homework assignments; ONLY ONE homework assignment will be dropped. No late or early homework will be accepted. Homework MUST be STAPLED TOGETHER with the CORRECT COVERSHEET for each chapter or it will NOT BE GRADED! (For an example of the homework coversheet see your instructor’s website.)

**Quizzes:** There will be given during the semester as determined by your instructor. The quizzes will consist of one question chosen from each section's assigned homework exercises. Each quiz will be worth a total of 10 points with partial credit possible. Quiz scores will be posted on Courseware once a week. The actual quiz will NOT be returned to the student. Solutions for each quiz will be posted online through your instructor's website.

**Chapter Projects:** Several projects will be assigned from selected chapters. These projects must have documented research and resources. The projects will be completed using a computer-based spreadsheet software program. The projects will not be accepted handwritten; projects must be printed from a computer software package like Excel or Lotus 1-2-3. Your name, HA number, class, section, semester and project title must be on the top coversheet. The research project as well as all supporting documentation must be attached to the top coversheet. No late projects will be accepted. No projects will be dropped. (For an example of the project coversheet see your instructor's website.)

**Tests:** There will be in-class tests during the semester as announced by your instructor. The dates of these tests are given in the course calendar provided by your instructor. You **MUST** bring your student ID to every exam! If it is necessary for you to miss an in-class test, please contact your instructor immediately and in advance whenever possible. There will be **NO** makeup tests; your final exam score will also serve to replace any **ONE** missed test.

**Extra Bonus Points for Each Test:** Each of the above three tests will have a selected number of "end of the chapter review exercises" assigned. This optional "test review" may be turned in at the beginning of class on the day of the respective test. The review assignment will be given a grade between 0-10 points, inclusive, and this grade will then be added at the end of the semester to each respective test. This will be the only way to add extra bonus points on the in-class tests.

**Final Exam:** There will be a mandatory, comprehensive multiple choice final exam. The date and time of the final exam is given in the course calendar provided to you by your instructor. The final exam will be in the normal classroom at the date and time specified by the university. If you score a 70% or better on the final exam, you will be given a course grade of at least a D- (minimum passing grade). **However, you must have a raw score of at least 50% on the final exam to be ELIGIBLE to pass this course. NO exceptions will be given to this rule!**

**Dropping the Course:** You are responsible for dropping this course and other registration issues. Do not depend on your instructor to drop you for any reason, and do not assume that your drop paperwork will be processed for you. Pay attention to drop deadlines and check VIP for your course status. If you want to be dropped let your instructor know in a timely fashion. Never assume that your drop will be processed automatically. Note that your paperwork must be turned in to the registrar's office on or before the last day to drop; it is not sufficient to have your teacher sign by the deadline, you must turn in the signed paperwork to the appropriate office by the deadline.

**Accommodations for testing** will be handled appropriately. Please talk with your instructor privately and have the documentation for testing accommodations available at the beginning of the semester. Retroactive testing accommodations will not be made.

**Cell phones** must be turned off or put on silent/vibrate mode before class begins.

**Cheating** will not be tolerated. See the UH Student Handbook for details and consequences.

**Online Help/Support** is available from the textbook publisher. For more info, see "Where to find help" above.

**Attendance** is important. Regular attendance in class is required if you are to pass this class. This course is highly dependent on previously covered material. If you miss class, you may miss important key concepts that are required and used in future material. The student has the responsibility of obtaining any missed lecture material or class notes from fellow classmates.

**Announcements** will be made at the beginning of the lecture, and/or on your instructor's website, and/or by email through your Courseware account. Your instructor reserves the right to make changes to the syllabus/policies of the course and to announce such information as needed. You are responsible for knowing the content of any announcements and/or changes.

**HOMEWORK: SUGGESTED “Skill Building Exercises” (S) & REQUIRED “Exercises” (R)**

<i>Section</i>	<i>Exercises</i>	
1.1	S # 1-13 odd, R # 1-15 all	
1.2	S # 1-15 odd, R # 1-10 all	
1.3	S # 1-11 odd, R # 1-7 all, 9, 11, 12	
1.4	S # 1-11 odd, R # 1, 3-7 all, 11-14 all	<i>Prepare Chapter 1 Homework Assignment #1</i>
2.1	S # 1-11 odd, R # 1, 2, 3, 5, 7, 8, 12, 14, 15, 19	
2.2	S # 1-11 odd, R # 1-7 all	
2.3	S # 1-11 odd, R # 1-6 all, 13, 15, 17, 18	
2.4	S # 1-11 odd, R # 1, 2, 4, 5, 6, 8, 16	
2.5 #2	S # 1-11 odd, R # 1-5 all, 18, 19	<i>Prepare Chapter 2 Homework Assignment</i>
3.1	S # 1-11 odd, R # 1-10 all	
3.2	S # 1-13 odd, R # 1-9 all	
3.3	S # 1-11 odd, R # 1-10 all	
3.4	S # 1-11 odd, R # 1-10 all	
3.5 #3	S # 1-11 odd, R # 1-6 all, 11, 12, 14, 15, 16, 17	<i>Prepare Chapter 3 Homework Assignment</i>
4.1	S # 1-11 odd, R # 1-7 all, 16, 17, 20	
4.2	S # 1-11 odd, R # 1-9 all, 16	
4.3	S # 1-11 odd, R # 1-5 all, 9, 15, 19	
4.4	S # 1-11 odd, R # 1-5 all, 13	
4.5 #4	S # 1-11 odd, R # 1-10 all	<i>Prepare Chapter 4 Homework Assignment</i>
5.1	S # 1-11 odd, R # 1-7 all	

- 5.2 S # 1-11 odd, R # 1-5 all  
5.3 S # 1-11 odd, R # 1-5 all, 13  
5.4 S # 1-11 odd, R # 1-11 odd  
5.5 S # 1-11 odd, R # 1, 2, 3, 19
- 

*Prepare Chapter 5 Homework Assignment #5*

- 6.1 S # 1-11 odd, R # 1-7 all  
6.2 S # 1-11 odd, R # 1-7 all  
6.3 S # 1-11 odd, R # 1, 4, 5, 7  
6.4 S # 1-9 odd, R # 1-5 all
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*Prepare Chapter 6 Homework Assignment #6*

## **Math 1311, Fall 2012 CORE project**

### **MATH 1311: Elementary Mathematical Modeling (formerly MATH 1315)**

Cr. 3. (3-0). Prerequisites: two credits of high school algebra, one credit of geometry and satisfactory score on the placement examination. May not apply to course or gpa requirements for a major or minor in natural sciences and mathematics. Students may not receive credit for both **MATH 1310** and **MATH 1311**. Functions, graphs, differences and rates of change, mathematical models, mathematics of finance, optimization, and mathematics of decision-making.

This course has a requirement that students use a TI 85 or better.

The syllabus is 4 chapters plus one section of the fifth chapter. There is homework assigned and graded. There are 2 or 3 tests during the semester plus a final. The teacher has total discretion to select homework problems, but the test questions **MUST** be based on the homework problems. The teacher may choose 2 or 3 semesterly tests to give.

## **Chapter 1 Functions**

Functions given by Formulas

Functions given by Tables

Functions given by Graphs

Functions given by Words

This chapter is covered in its entirety. Care is taken to help the students apply the definition of function in the various settings. There are many representations of functions and each is discussed with the aim of presenting the similarities as well as the differences. Students are often asked to represent a function several ways in one problem.

Most problems involve facts from real world situations. It is common to ask the students to provide an extension of the material as the last of a series of questions.

Chapter 1, Section 1, Problem 11

How much can I borrow? The function in Example 1.2 can be rearranged to show the amount of money  $P = P(M, r, t)$ , in dollars that you can afford to borrow at a monthly interest rate,  $r$  (as a decimal) if you are able to make  $t$  monthly payments of  $M$  dollars:

$$P = M \times \frac{1}{r} \times \left(1 - \frac{1}{(1+r)^t}\right)$$

Suppose you can afford to pay \$350 per month for four years.

- A. How much money can you afford to borrow for the purchase of a car if the prevailing monthly interest rate is 0.75%? (That is 9% APR). Express the answer in functional notation and then calculate it.
- B. Suppose your car dealer can arrange a special monthly interest rate of 0.25% (or 3% APR). How much can you afford to borrow now?
- C. Even at 3% APR you find yourself looking at a car you can't afford, and you consider extending the period during which you are willing to make payments to 5 years. How much can you afford to borrow under these conditions?

This is a fairly typical scenario – the topic is pertinent to the students' experience. Note that part C asks them to extend the work to a hypothetical situation. This problem has them working hard on creative financing, synthesis of facts, and the extension of the work.

Chapter 1, Section 2, Problem 12 C.

Growth in weight: The following table gives, for a certain man, his weight  $W = W(t)$  in pounds at age  $t$  in years. [chart omitted;  $t$  start at 4 years and increments in 4 year periods to 24 years]

- A. Make a table showing the average yearly change in  $W$ .
- B. Describe in general terms how the man's gain in weight varied over time.
- C. Estimate how much the man weighed at age 30.
- D. Use the average rate of change to estimate how much he weighed at birth.  
Is your answer reasonable?

This question involves pattern recognition, extrapolation, presenting functions of functions and analysis. Especially asking "Is your answer reasonable?" demonstrates the real world view point of most of the problems we work on in this class.

Chapter 1, Section 3, Skill Building

A function is given by the following graph. [omitted]

Where is the graph decreasing?

Where does the graph reach a maximum, and what is that maximum value?

Each section has a “Skill Building” set of problems that help students focus on the patterns using their new vocabulary, and reviewing the themes of the section. Most often, the skill building problems are worked in class, but occasionally they are assigned as homework.

Chapter 1, Section 4, Problem 7

You pay your secretary \$6.25 per hour. A stamped envelope cost 38 cents, and regular stationery cost 3 cents per page, but fancy letterhead stationery costs 16 cents per page. Assume that a letter requires fancy letterhead for the first page but that regular paper will suffice for the rest of the letter.

- A. How much does the stationery alone cost for a 3-page letter?
- B. How much does it cost to prepare and mail a 3-page letter if your secretary spends 2 hours on typing and corrections?
- C. Use a formula to express the cost of the stationery alone for a letter as function of the number of pages in a letter. Identify the function and each of the variables you use, and state the units.
- D. Use a formula to express the cost of preparing and mailing a letter as a function of the number of pages in the letter and the time it takes your secretary to type it. Identify the function and each of the variables you use, and state the units.
- E. Use the function you made in part B to find the cost of preparing and mailing a 2-page letter that it takes your secretary 25 minutes to type.

This is all about critical thinking skills. The student has the opportunity to create a function and then refine it to make it more realistic. Then the formula gets used and extended.

Chapter 1 Review Exercises – the review exercises are most often the source of test questions

15. The graph in Figure 1.55 [omitted] gives the height  $H$ , in feet, of second-growth longleaf pines for various ages,  $a$ , in years.

- A. Describe how the height of the trees changes with age. Why is this reasonable?
- B. What is the tree height for a 60-year-old tree?
- C. Is there a limiting value to the height of these trees? Why?
- D. Describe the concavity of the graph and explain what it means in practical terms.

## **Chapter 2 Graphical and Tabular Analysis**

Tables and Trends

Graphs

Solving Linear Equations

Solving Nonlinear Equations

This chapter presents more on limiting values, a concept that students find difficult initially. The problems help them see the reasonable nature of limits, though by careful graphs, tables, charts, and examples.

The questions involve a mixture of computational matters to be done and a followup analysis of what the table or graph provides in terms of information.

Chapter 2, Section Three, Problem 3

Resale value:

The resale value  $V$ , in thousands of dollars, of a boat is a function of the number of years  $t$  since 2001, and the formula is

$$V = 12.5 - 1.1t$$

- A. Calculate  $V(3)$  and explain in practical terms what your answer is.
- B. In what year will the resale value be \$7,000?
- C. Solve for  $t$  in the formula to obtain  $t$  as a function of  $V$ .
- D. In what year will the resale value be \$4,800?

Here is a real life scenario with the practical and computational aspect in Part A, an application that extends the computation to understanding the various bits of the formula in Part B, followed by an abstract bit of work in C and a computational question in Part D.

Chapter 2, Section 4, Problem 6

A cup of coffee: The temperature  $C$  of a fresh cup of coffee  $t$  minutes after it is poured is given by:

$$C = 125e^{-0.03t} + 75^\circ F$$

The coffee is cool enough to drink when its temperature is 150 degrees F. When will the coffee be cool enough to drink?

Again, practical combined with needing to understand what is being asked and how to use both the technology and the formula to provide an answer.

## **Chapter 3    Straight Lines and Linear Functions**

The Geometry of Lines

Linear Functions

Modeling Data with Linear Functions

Linear Regression

Systems of Equations

A basic chapter, covered in full, that provides the spectrum of standards. The two initial sections are review of high school material. The third section gets to the heart of the course and challenges students to see linear patterns and be able to extract the formula from the pattern. Linear regression is a new skill for most of the students and care is taken to discuss appropriateness of the model. Systems of equations provides challenging problems for them to analyze.

Chapter 3, Section 1, Problem 16

An underground water source: An underground aquifer near Seiling Oklahoma, sits on an impermeable layer of limestone. West of Seiling, the limestone layer is thought to slope downward in a straight line. In order to map the limestone layer, hydrologists started at Seiling heading west and drilled sample wells. Two miles west of Seiling the limestone layer was found at a depth of 220 feet. Three miles west of Seiling the limestone layers was found at a depth of 270 feet.

What would you expect to be the depth of the limestone layer 5 miles west of Seiling?

Chapter 3, Section 3, Problem 4A

Lead note: The background for this exercise can be found in Exercises 5 and 6 in Section 3.2 [which are assigned].

The following table gives the total cost  $C$ , in dollars, for a widget manufacturer as a function of the number of  $N$  widgets produced during a month. [table omitted]

- A What are the fixed costs and variable costs for this manufacturer?
  
- B The manufacturer wants to reduce the fixed costs so that the total cost at a monthly production level of 350 will be \$12,975. What will the new fixed cost be?
  
- C Instead of reducing the fixed costs as in Part B, the manufacturer wants to reduce the variable cost so that the total cost at a monthly production level of 350 will be \$12,975. What will the new variable cost be?

Chapter 3, Section 5, Problem 8

Market supply and demand: The quantity of wheat, in billions of bushels, that wheat suppliers are willing to produce in a year and offer for sale is called the *quantity supplied* and is denoted by  $S$ . The quantity supplied is determined by the price  $P$  of wheat, in dollars per bushel, and the relation is  $P = 2.65S - 0.75$ .

The quantity of wheat, in billions of bushels, that wheat consumers are willing to purchase in a year is called the *quantity demanded* and is denoted by  $D$ . The quantity demanded is also determined by the price  $P$  of wheat, and the relation is  $P = 2.65 - 0.55D$ .

At the equilibrium price, the quantity supplied and the quantity demanded are the same. Find the equilibrium price for wheat.

## Chapter 4 Exponential Functions

Exponential Growth and Decay

Modeling Exponential Data

Modeling Nearly Exponential Data

Logarithmic Functions

Connecting Exponential and Linear Data

This chapter introduces another family of functions within the same framework as Chapter 3, a review then modeling. The added feature here is that the material extends to the logarithms and the relationship between the two families are covered in detail. The chapter extends the treatment of exponential functions and logarithmic functions substantially from the high school presentation in a manner that starts with what they know while building slowly and logically.

The final section is a surprise to most students. They find it fascinating and the problems are especially nice in this section.

Chapter 4, Section 2, Problem 14

Wages: A worker is reviewing his pay increases over the past several years. The table below shows the hourly wage  $W$ , in dollars, that he earned as a function of time  $t$ , measured in years since the beginning of 1990. [table omitted]

- D. Find a formula giving an exponential model for  $W$  as a function of  $t$ .

Chapter 4, Section 3, Problem 4 B and C

Brightness of stars: Refer to Example 4.10 for the relationship between relative intensity of light and apparent magnitude of stars.

B The star Antares has an apparent magnitude of 0.92. How does the intensity of light reaching Earth from Antares compare with that of light from Vega?

C If the intensity of light striking Earth from one star is twice that of light from another, how do the stars' magnitudes compare?

Chapter 4, Section 5 Problem 16

Atmospheric Pressure: The following table [omitted] gives a measurement of atmospheric pressure, in grams per square centimeter, at the given altitude, in kilometers.

- A Plot the natural logarithm of the data and find the equation of the regression line for the natural logarithm of the data.
  
- B Make an exponential model for the data on atmospheric pressure using the logarithms as a link.
  
- C What is the atmospheric pressure at an altitude of 30 kilometers?

## **Chapter 5    A Common Survey of Other Functions**

Power Functions

Modeling Data with Power Functions

Combining and Decomposing Functions

Quadratic Functions and Parabolas

Higher-degree Polynomials and Rational Functions

Only the first section of this chapter is used in the course. The link to polynomial functions is stressed. Students find this particular material quite reasonable and rapidly learn the techniques for identifying power function patterns.

Chapter 5, Section 1, Problem 4

Weight and length: A biologist has discovered that the weight of a certain fish is a power function of its length. He also knows that when the length of the fish is doubled, its weight increases by a factor of 8. What is the power  $k$ ?